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Abstract

Fabrication Of Fused UO_2, UC Feed Material And Cast UC Rods.

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Under sponsorship of the Joint US-EURATOM Program NUKEM has been carrying out development work on swaging and vibrational compaction of UO_2 and on the fabrication of UC feed material and cast rods. The first part of this paper describes a new technique for producing fused UO_2 suitable for vibrational compaction. In the second part research results on preparing stoichiometric UC and on casting UC in a centrifugal casting furnace are briefly summarized. A description of a production line for the manufacturing of 4.4 tons of cast UC rods for the EURATOM research centre at Ispra and the experience gained during the production are presented in more detail.

UO_2 is melted by passing an electric current through a column of loosely pressed UO_2 pellets stacked together between two electrodes. The furnace can be operated semicontinuously producing about 8 kg of fused UO_2 per batch with virtually no loss from the initial column of pellets. The crushed UO_2 is annealed in hydrogen to obtain an O/U ratio approximating 2.00. Analytical results show that the carbon content is below 100 ppm. The average nitrogen and hydrogen content is 50 and 10 ppm, respectively.

In UC development work stoichiometric feed material for melting was prepared by mixing UO_2 and graphite, pelletizing without a binder and reacting in a vacuum induction furnace at temperatures above 1600°C. The feed material was melted and cast into cylindrical rods in a centrifugal skull melting furnace. The carbon content was held to $\pm$ 0.1 wt% of the stoichiometric value. The average oxygen content amounted to 500 ppm.

The UC production consists of the following stages: Mixing of UO_2 and graphite, pelletizing, reacting to form the carbide, melting and casting, cutting and grinding, degreasing and annealing, dimensional control and packaging. The two main pieces of equipment used are a semicontinuous reaction furnace for the production of the feed material and an automatic tilt pour skull melting furnace. The production rate of the reaction furnace is 3 kg of UC per hour, and that of the melting furnace 50 kg of cast slugs in a day's shift. The carbon content can be kept within $\pm$ 0.1 wt% of the desired value. The average oxygen content is 500 ppm.